

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN AND RELATING TO PROCESS FOR THE SUSPENSION OF FIBRES

(71) We, UNILEVER LIMITED, a company organised under the laws of Great Britain, of Unilever House, Blackfriars, London, E.C.4, England, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in and relating to a process for the suspension of fibres, particularly to suspensions of fibres for use on non-woven fabric machines.

It is known that non-woven fabrics are produced by placing an aqueous suspension of fibres on a water-permeable surface, on which the fibres form a tangled mass while the water drains away. To achieve both good strength and an even look-through, it is desirable to use fibres which are as long as possible and as fine as possible. On the other hand, the longer and finer the fibres used the more difficult it is to achieve the required even dispersion of fibres in the stock box. Increasing the length of the fibres above 30—40 mm gives practically no improvement in strength and in the required textile character. As difficulties are experienced in practice in obtaining even dispersion of fibres of these lengths, fibre lengths of 6—15 mm are usually accepted.

In order to increase the production capacity of non-woven fabric machines the aim is to have a high concentration of stock in the stock box. This is still subject to severe restrictions due to the methods at present known. One essential requirement for an even dispersion of fibres in the stock box is that the fibres should be well separated and dispersed when the stock is screened. It is just as important, however, to prevent as far as possible the fibres being spun together en route to the non-woven fabric machine after they have been dispersed. At present, there are basically two known methods of dispersing the stock. One method consists in mechanically dispers-

ing the fibres in a vat with the suspension water, to which other additives such as wetting agents, defoamers, fillers or dyes may be added which dispersion may be effected, for example, by means of a radial pump impeller, or, in the case of longer fibres by means of a propeller. Another, older, suggestion is to induce the kinetic energy in the suspension water not by means of a propeller but by passing the suspension water into the dispersion tank at high speed at the same time as the fibres are fed in. Although the known methods work satisfactorily especially for dispersing short staple fibres, they do have a number of deficiencies which are more obvious the longer and finer the fibres to be processed.

In these known processes, the flow conditions in the mixing vessel can only be adjusted very roughly. In particular, they cannot be reproduced or controlled in the small local zones of the tank which are only the size of several fibre lengths. This has an adverse effect on the overall dispersion of the suspension, as there is a risk that fibres already dispersed in the suspension will subsequently spin together, i.e. owing to the uncontrolled agglomeration of several fibres knots will be formed, which will form sections of unevenly dispersed mass in the fabric made from this stock. Agglomerations of this type have the effect, especially when longer fibres are used, of pulling other fibres along with them like an avalanche and thus spoiling large parts of the stock suspension or even making them unusable. More particularly, however, the effective forces in the known processes are so slight in the local zones which are about the size of the fibre length that they are often not sufficient to separate the individual fibres from the bundle of fibres. This applies especially where the fibres are already slightly felted before they are fed into the tank, as may happen, for example, if they have been previously dried, and again if staple fibres from thermoplastic materials have not been cleanly

cut. In this case, at least some of the fibres remain in the suspension liquid as bundles of parallel strands which later on prevents the satisfactory formation of a fabric.

5 In the known dispersing processes, a system of at least one pump, a mixer and relatively long pipelines are necessary to convey the fibre suspension from the dispersing device to the stock box of the non-woven fabric machine. With this system there is a danger of the fibres spinning together because of poor flow conditions. The longer and finer the fibres the greater this danger is.

10 For these reasons it is not possible with the processes and devices so far known to achieve an even dispersion with stock densities above 0.1—0.2 grammes/litre in the stock box.

15 The present invention relates to a process and a device for forming a suspension of and conveying fibres, especially for the preparation of stock for non-woven fabric machines, which avoid the disadvantages mentioned and also provide a series of further advantages.

20 According to one aspect of the present invention there is provided a process for forming a dispersed suspension of fibres comprising feeding a mixture of fibres and a part of the liquid required to form the suspension tangentially into a substantially annular passage having a cross-sectional area decreasing away from the inlet, the passage having inner and outer walls relatively rotating to separate and disperse the fibres in the suspension liquid as the mixture passes through the annular passage, adding further suspension liquid to the suspension in the annular passage at at least one location, and passing the dispersed suspension out of the annular passage through an annular outlet slot.

30 In this process according to the invention the flow conditions are clearly defined and reproducible even in the smallest zones of the suspension down to the size of the diameter of a fibre. The length of time the fibres are in suspension is considerably less with the process according to the invention. This lessens both the danger of the fibres spinning together and the amount the fibres swell owing to the absorption of water. The latter is especially important for more rapid drying and the better shape stability of the non-woven fabric during its manufacture. In particular, the fibres move continually from the zones where the degree of dispersion due to the shearing stresses which occur in the suspension between the relatively moving inner and outer walls of the annular passage is lowest to the zones with a higher degree of dispersion, i.e. greater separation of the fibres, without any mixing of the zones. This guarantees a steady increase in the degree of dispersion as quickly as possible and almost entirely prevents the separate fibres spinning together after separation.

65 Preferably a major proportion of the liquid

required to form the suspension is added to the suspension whilst it is passing through the annular passage. The addition of suspension liquid in the annular passage makes it possible to influence the boundary layer as required in the annular passage. The suspension liquid is preferably added at a plurality of locations spaced apart in the direction of flow through the annular passage so that the boundary layer can be influenced at various locations.

70 Conveniently the suspension is subjected to a centrifugal force as it leaves the annular passage so that the discharge velocity of the fibre suspension through the annular outlet is sufficient to convey the suspension directly to a non-woven fabric machine. This removes the necessity for pumps or mixers to convey the suspension to the stock box of a non-woven fabric machine and the possibility of the fibres spinning together again is minimised.

75 The advantages of the present process make it possible to maintain a uniform dispersion of the stock in the stock box of the non-woven fabric machine at much higher concentrations than was previously possible. Experience has shown, for example, that it is possible to maintain a stock concentration of 0.4—0.5 grammes/litre in the stock box in the case of textile staple fibres with completely even stock dispersion.

80 Additives such as fillers or binders required in the final suspension can be fed to the suspension at one or more locations spaced apart in the direction of flow of the suspension through the annular passage. Alternatively the additives can be fed to the suspension immediately after it leaves the annular outlet slot.

85 Conveniently the final concentration of the suspension can be adjusted by the addition of the suspension liquid to the suspension immediately it leaves the annular outlet slot.

90 According to another aspect of the present invention there is provided apparatus for forming a dispersed suspension of fibres comprising a hollow housing having a smooth internal bore, an inlet and an outlet each communicating with respectively opposite ends of the bore, a rotor rotatably mounted within the housing and having a smooth external surface, the bore of the housing and the external surface of rotor defining the outer and inner walls respectively of an annular passage of decreasing cross-section away from the inlet, and a plurality of circumferential inlet channels spaced apart in the bore of the housing and adapted to be connected to a source of suspension liquid.

95 A mixture of the fibres and part of the suspension liquid can be fed through the inlet to pass through the annular passage. The walls of the passage are so smooth that no fibres stick to them. Shearing stresses are imparted to the mixture by the relative rotation of the

walls of the annular passage to separate and disperse the fibres and form a suspension. The shearing stresses increase as the suspension, flowing in a spiral path, flows through the annular passage due to the decreasing cross-sectional area of the passage. The addition of suspension liquid through the circumferential outlet channels in the bore of the housing enables the boundary layer of the flow to be influenced at those locations.

Conveniently a central supply channel for further suspension liquid to be fed to the annular passage can be provided, the central channel communicating with a circumferential slot in the inner wall of the annular passage.

Preferably there is provided a centrifugal disc secured to the rotor at the outlet end of the annular passage, the periphery of the centrifugal disc co-operating with a lip formed on the housing to form an annular outlet slot. The centrifugal disc acts as a radial pump. Particularly when the apparatus is located adjacent the stock box of the non-woven fabric machine only very short pipelines are required and the possibility of the fibres spinning together in the suspension is minimised. There is advantageously provided means for adjusting the position of the rotor in the axial direction relative to the bore of the housing to vary the width of the annular outlet slot. This adjustment provides for the width of the outlet slot to be adjusted from a width corresponding to the diameter of the fibres being processed to a width of several millimetres.

To minimise eddies at the annular outlet slot a circumferential opening can be located adjacent each side of the annular outlet slot, said circumferential openings being adapted to be connected to separate sources of liquid supply. These circumferential openings can be used to feed additional suspension liquid or additives to the suspension.

Preferably there is provided a discharge chamber communicating with the annular outlet slot and a tangential outlet from said discharge chamber.

The process and apparatus according to the invention will now be more particularly described with reference to the accompanying diagrammatic drawings illustrating one embodiment of apparatus according to the invention, in which:

Figure 1 is a vertical cross-section through a dispersion device according to the invention;

Figure 2 is a horizontal section along the line II—II of Figure 1; and

Figure 3 is a horizontal section along the line III—III.

The apparatus as shown in the drawings comprises a hollow stationary outer housing 1 having a truncated conical inner bore 2, the diameter of the bore decreasing towards the lower end of the casing.

Vertically mounted within the housing 1

is a rotor 3 supported on upper and lower bearing assemblies 4 and 5 respectively, the lower assembly being secured by a bearing cap 5a. The rotor 3 and the bore 2 of the housing together define an annular passage 6 of decreasing cross-section towards the lower end 6a of the passage, the outer walls 7 of the rotor 3 and the bore 2 of the housing being so smooth that no fibres of the material to be processed can stick to them. The upper bearing assembly 4 is threadably mounted at 8 in the top wall of the housing to provide for adjustment of the position of the rotor relative to the outer housing in the axial direction of the annular passage 6 and can be locked in the desired position by means of set screws 9 mounted on lugs 10 extending from the bearing assembly.

Within the housing the bearing assembly 4 is protected by a stationary shroud 11 secured to the housing and which carries a seal 12 sealing with the rotor 3. The inner bore of the housing is formed to follow the configuration of the shroud and a feed funnel 13 connects with a tangential inlet passage 14 at the upper end of the housing.

The lower end of the rotor 3 is flared to form a centrifugal disc 15, the outer edge 16 of the disc 15 co-operating with a corresponding lip 17 on the housing to form an annular outlet slot 18. The outlet slot 18 communicates with an annular diffuser discharge chamber 19 and an adjacent spiral casing 20 leading to a tangential outlet passage 21 with a discharge opening 22.

The bore 2 of the housing 1 is provided with a number of circumferential inlet channels 23 opening into the annular passage 6, each of the channels being connected to four supply pipes 24 (Figure 3) via passages 25 within the housing. Towards the lower end of the housing, four supply pipes 26 (only two of which are shown) communicate with a circumferential opening 27 in the housing adjacent the lip 17 on the housing at the upper edge of the edge 16 of the disc 15. A lower circumferential opening 28 adjacent the underside of the edge 16 of the disc 15 communicates with four supply pipes 29.

A central supply channel 30 is formed in the top of the rotor leading via passages 31 to enter the annular passage through a circumferential slot formed between the shroud 11 and the rotor.

In operation fibres are fed into the feed funnel 13, e.g. from a conveyor 32, and a part of the water in which the fibres are to be suspended is dosed into the feed funnel by a spray 33.

With the rotor rotating at a speed of approximately 4,000 rpm. in the clockwise direction as viewed in Figures 2 and 3 the mixture of the fibres and water passes through the tangential inlet passage 14 past the bearing shroud 11 and into the annular passage 6.

The distance between the shroud 11 and the bore at that zone is several centimetres. Because in this zone where the mixture of fibres and water enter the annular passage is defined between the stationary shroud 11 and the stationary housing a minimum of air is sucked in by the subsequent rotation of the suspension, the rotation of the suspension in this zone being greatly weakened, the pulped fibres being carried along continually in increasing amounts as the rotation of the suspension strengthens towards the annular passage 6. In its path through the annular passage the suspension flows in a tight helix and is diluted in its path by additional water being fed into the passage via one or more of the supply pipes 24 and the circumferential channels 23. This addition of water through the channels 23 makes it possible to influence the boundary layer of the flow at the various locations of the channels 23. Owing to the current between the rotor 3 rotating at high speed and the stationary housing 1, and the rotor having a large circumference compared with the length of the fibres, shearing stresses occur increasing as the cross-sectional area of the passage decreases towards the lower end of the passage, the shearing stresses being sufficient to split up and disperse even severely felted bundles of fibres.

Further water can also be added via the central supply channel 30 and holes 31 to enter the passage between the shroud 11 and the rotor 3.

At the lower end 6a of the annular passage the suspension flows across the centrifugal disc 15 and is flung from the peripheral edge 16, the disc acting as a radial pump, to pass through the annular outlet slot 18 and into the diffuser chamber 19. The width of the outlet slot 18 is adjusted by means of the threaded mounting 8 and locked in position by the set screws 9 according to the size and throughput of the fibres being processed.

To minimise eddy currents at the outlet slot water can be supplied via the supply pipes 26 and 29 to the circumferential openings 27 and 28 adjacent the outlet slot, this addition of water also being useful to adjust the final concentration of the suspension required at the stock box of a non-woven fabric machine for which the suspension is required.

From the diffuser chamber 19 the suspension flows round the spiral casing 20 and is discharged along the tangential outlet passage 21 and through the discharge opening 22. Because the suspension leaves the annular outlet slot from the centrifugal disc at a high velocity no pumps are necessary to convey the suspension along pipelines to the stock box. If the apparatus is located adjacent the stock box the apparatus and the stock box can advantageously be connected by very short pipelines.

Any additives, e.g. fillers and binders, required in the suspension can be added via the circumferential channels 23 or preferably via the circumferential slots 27 and 28.

In order to increase the throughput of the apparatus it is also possible to feed the mixture of fibres and water under pressure.

WHAT WE CLAIM IS:—

1. A process for forming a dispersed suspension of fibres comprising feeding a mixture of fibres and a part of the liquid required to form the suspension tangentially into a substantially annular passage having a cross-sectional area decreasing away from the inlet, the passage having inner and outer walls relatively rotating to separate and disperse the fibres in the suspension liquid as the mixture passes through the annular passage, adding further suspension liquid to the suspension in the annular passage at at least one location, and passing the dispersed suspension out of the annular passage through an annular outlet slot.

2. A process according to claim 1 in which a major proportion of the liquid required to form the suspension is added to the suspension whilst it is passing through the annular passage.

3. A process according to claim 2 in which suspension liquid is added at a plurality of locations spaced apart in the direction of flow through the annular passage.

4. A process according to any one of the preceding claims in which the suspension is subjected to a centrifugal force as it leaves the annular passage so that the discharge velocity of the fibre suspension through the annular outlet is sufficient to convey the suspension directly to a non-woven fabric machine.

5. A process according to any one of the preceding claims in which additives are fed to the suspension at one or more locations spaced apart in the direction of flow of the suspension through the annular passage.

6. A process according to any one of the preceding claims in which additives are fed to the suspension immediately after it leaves the annular outlet slot.

7. A process according to any one of the preceding claims in which the final concentration of the suspension is adjusted by the addition of suspension liquid to the suspension immediately it leaves the annular outlet slot.

8. Apparatus for forming a dispersed suspension of fibres comprising a hollow housing having a smooth internal bore, an inlet and an outlet each communicating with respectively opposite ends of the bore, a rotor rotatably mounted within the housing and having a smooth external surface, the bore of the housing and the external surface of rotor defining the outer and inner walls respectively of an annular passage of decreasing cross-

- section away from the inlet, and a plurality of circumferential inlet channels spaced apart in the bore of the housing and adapted to be connected to a source of suspension liquid via passages within the housing connected to supply pipes.
- 5 9. Apparatus according to claim 8 comprising a central supply channel for suspension liquid to be fed to the annular passage, the central channel communicating with a circumferential slot in the inner wall of the annular passage.
- 10 10. Apparatus according to claim 8 or claim 9 comprising a centrifugal disc secured to the rotor at the outlet end of the annular passage, the periphery of the centrifugal disc co-operating with a lip formed on the housing to form an annular outlet slot.
- 15 11. Apparatus according to claim 10 comprising means for adjusting the position of the rotor in the axial direction relative to the bore of the housing to vary the width of the annular outlet slot.
12. Apparatus according to claim 10 or claim 11 comprising a circumferential opening located adjacent each side of the annular outlet slot, said circumferential openings being adapted to be connected to separate sources of liquid supply.
- 25 13. Apparatus according to claim 10, 11 or 12 comprising a discharge chamber communicating with the annular outlet slot and a tangential outlet from said discharge chamber.
- 30 14. A process for forming a dispersed suspension of pulped fibres substantially as hereinbefore described with reference to the accompanying drawings.
- 35 15. Apparatus for forming a dispersed suspension of pulp fibres substantially as hereinbefore described with reference to the accompanying drawings.
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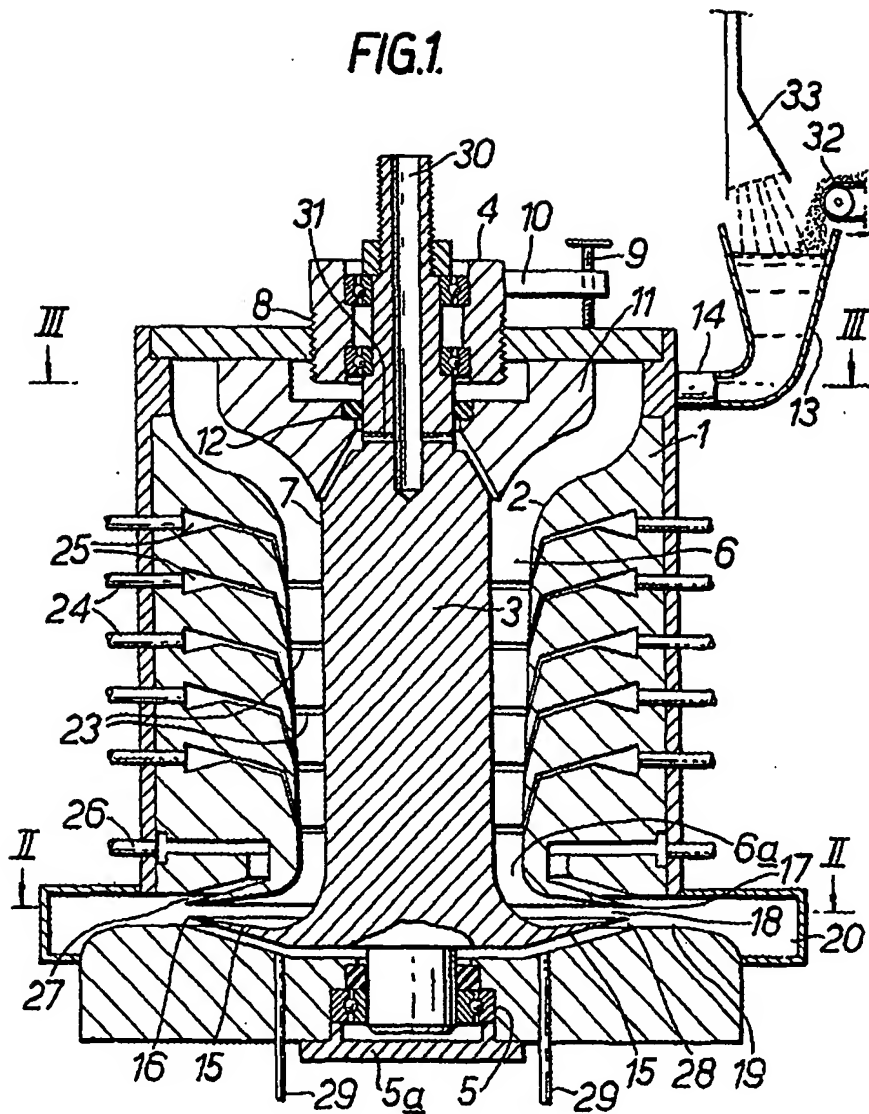
COMPLETE SPECIFICATION

2 SHEETS

This drawing is a reproduction of
the Original on a reduced scale

Sheet 1

FIG.1.



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COMPLETE SPECIFICATION

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Sheet 2

FIG.2.

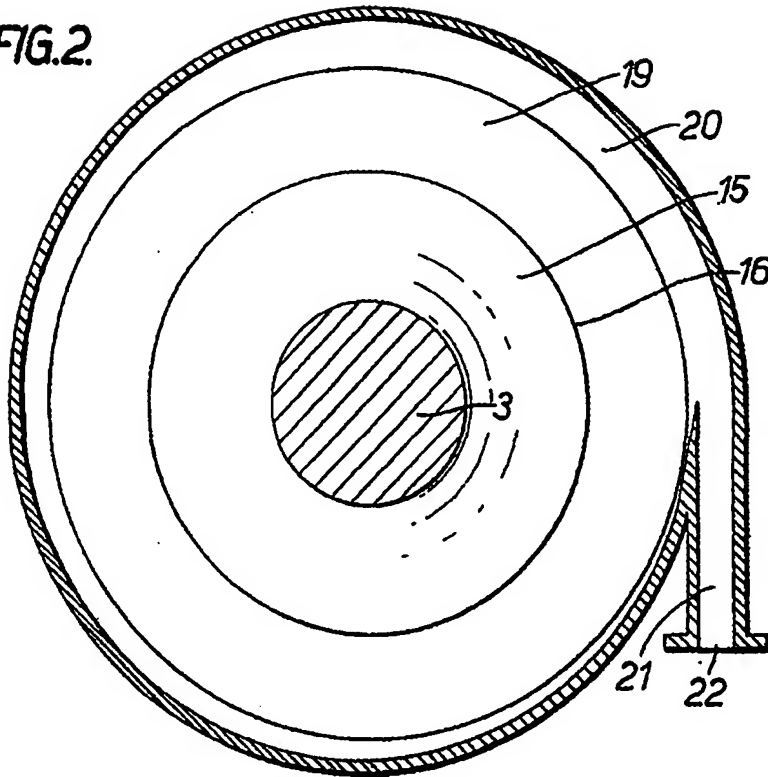


FIG.3.

